Check List 8(4): 600–609, 2012

ISSN 1809-127X (available at *www.checklist.org.br*)

Check List
Journal of species lists and distribution

LISTS OF SPECIES

The Flora Composition of Sabang Island, Aceh, Indonesia

Asyraf M.[1*], Rahmad Zakaria[1], Mashhor Mansor[1], Musri Musman[2] and Abu Husin Harun[3]

1 School of Biological Sciences, Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia.
2 Lembaga Penelitian, Universitas Syiah Kuala, Banda Aceh, Aceh, Indonesia.
3 Forest Research Institute of Malaysia, Kepong, Kuala Lumpur, Malaysia.
* Corresponding author. E-mail: *asyrafm@usm.my*

ABSTRACT: We provide a checklist of Angiosperms from a rapid flora inventory of Sabang Island, Aceh, Indonesia. This inventory, conducted in April 2010, was carried out to prepare a baseline data of the floral composition in the north-western island archipelago of Aceh. In this exercise, we covered a total of 7 plots (0.2 ha each) and 120 quadrats (1x1 m each) in 7 sampling locations within the island. In total, we recorded 325 species from 211 genera of 68 families. Nine predominant families (i.e. family with ≥ 10 species) are Euphorbiaceae (32 species), Cyperaceae (19 species), Fabaceae (17 species), Moraceae (15 species), Meliaceae (13 species), Lauraceae and Sterculiaceae (12 species, respectively), Rubiaceae (11 species) and Annonaceae (10 species). The volcanic soil of the island could have played a significant role in defining species composition and their abundance. On the non-woody species' composition and abundance, the increasing magnitude of anthropogenic activities, for example, road and pathways constructions into the forested area, could have enhanced propagule dispersal of non-native plants into the area.

INTRODUCTION

Tropical regions are known as places with vast tropical evergreen rain forests, unique formations and harbour great number of plant and animal species (Aiken and Leigh, 1992; Whitmore, 1984). The Sundaland countries, such as Indonesia and Malaysia, are examples of countries which are rich in different species (Slik *et al.* 2011). They are mapped as part of the world's hotspot regions of flora and fauna (Turner 1989; Manokaran and Swaine 1994; Condit *et al.* 1996; Takyu *et al.* 2005; Nizam *et al.* 2006; Zakaria *et al.* 2009) with high richness and diversity of flora and fauna. However, changes in species composition and diversity could occur overtime due to both natural phenomena and anthropogenic activities where in the later case, a never ending threat to flora and fauna diversity (e.g. Fuller *et al.* 2010).

A well known natural disaster which had occurred in the Aceh region - the tsunami of December 2004 - prompted several studies, conducted along the coastal vegetation of the affected areas in Southeast Asia (e.g. Mangkoedihardjo 2008; Tanaka 2009). Most of these studies focused on the importance of coastal vegetation as buffer zones, protecting the inland area from the tide. Another particular issue was the changes of the vegetation's composition, post-tsunami event. For example, studies conducted by Mattsson *et al.* (2008) in Sri Lanka and Hayasaka *et al.* (2009) in Thailand as well as the intrusion of invasive weedy species (Rasingam and Parthasarathy 2009). In recent review by Corlett (2010) discussing on the alien species invasion into Tropical East Asia (TEA) islands, the author concluded that although current impact on local plant is minimal, the long term effect on population dynamic of endemic species cannot be ignored.

However, understanding the relationship between biodiversity and the functioning ecosystem can be quite a challenge for ecologists (Davis and Richardson 1995). Since both natural disasters and man-made activities can intensify the changes in both biodiversity and structural characteristics of a given community, ecologists need to examine the interconnected characters of different communities. An already distinguished character in a community is the floristic composition (Danserau 1960) and with increasing human intrusion into forested area, changes to the species' composition are unavoidable.

One alarming change in the flora composition as observed in Banda Aceh, is the intrusion of invasive species, i.e. *Mimosa pigra,* a semi-aquatic legume which has been observed to be thriving in several locations within the boundary of the town (Mashhor Mansor, personal observation 2002). Thus, as part of the preventive measures as well as a collaborative effort between Universiti Sains Malaysia and the Universitas Syiah Kuala to provide a baseline data for the flora composition post-tsunami-event.

A rapid assessment was carried out between 20th to 30th April 2010, specifically on the flora of Sabang Island (herein forth Weh Island).

MATERIALS AND METHODS

Study site

The Weh Island is located on a tectonically active zone of South East Asia (Verstappen 2005). It is bordered by Peninsular Malaysia on the eastern part and is the northern most part of Indonesia (Figure 1). Given the fact that this island is a volcanic island (stratovolcano) from the Quaternary period, ultisol has been discovered to be the major soil type (Gasparon 2005). Thus, the organic layer is low due to its fast decomposing rate. Although this is a tropical island, in terms of general weather pattern; the temperature can be lower than average. This is most likely due to the oceanic current effect. There are two distinct seasons, the dry months from February-August and wet months from September-January.

A rapid assessment was conducted from the 20th to

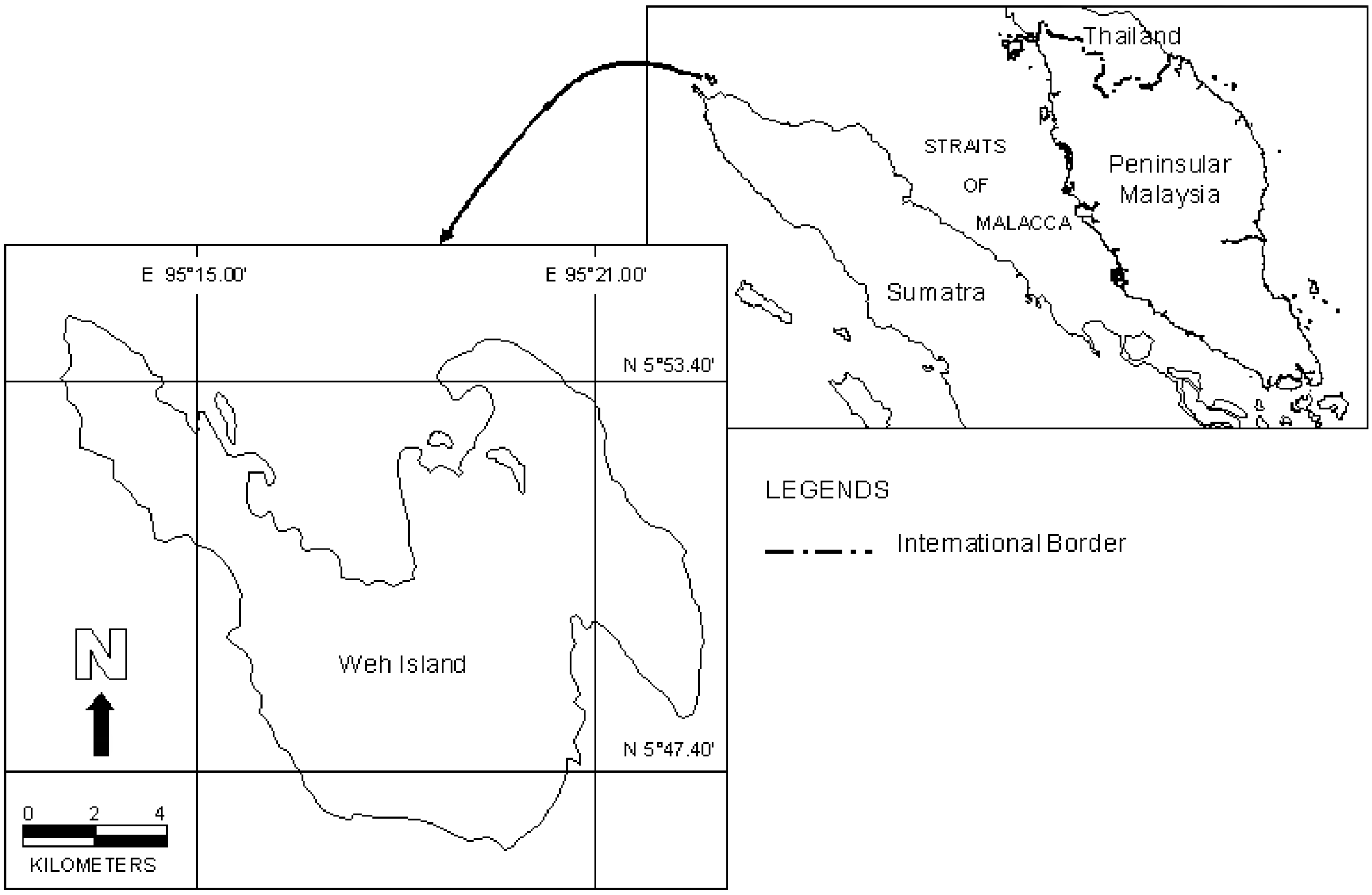

FIGURE 1. Location of Sabang Island (also known as Weh Island), Indonesia.

27th April, 2010 to provide a general overview on the status of plant diversity on the island. Through impromptu interviews with the local communities, we have established that the most affected area during the tsunami event was along the rocky coastal zone, east-west of Weh Island. However, due to its location, the damage was minimal in comparison to Banda Aceh.

To assess the flora composition of Weh Island, we divided the island into four main localities; 1) the northeast part of Sabang which consists mainly of relatively undisturbed primary forest, 2) the rocky coastal forest most affected by the tsunami in December 2004, 3) the central zone of Weh Island where forested area had been converted to agriculture land, and 4) the secondary forested area with combinations of fragmented agricultural land and primary forest. Apart from the local agricultural activities hub at the centre of the island, other economic activities of this island are related to tourism and sport fishing activities in nearby sandy beaches, to the north and southeast of the island. The most developed area of Weh Island is on the north and south-eastern part (township and port). In total, we managed to establish 7 sampling sites. Sampling sites were specifically chosen to represent a variety of plant habitat (Table 1). Most of these sites are not protected by law, but limited accessibility has protected these areas from major human intrusion. The elevation of these sites extended from 50 m to 370 m above sea level. The habitat types covered in this study ranges from primary coastal forest, primary lowland forest, hill forest, and riverine disturbed forest.

Species assessment

To assess the species composition, we deployed two methods; 1) 20 x 100 plots for timber and tall standing woody trees and 2) modified belt-transect sampling method for non-woody plant. For woody species, all free-standing woody plant species within the plots were enumerated. All stems ≥ 2 cm in diameter at breast height (DBH at 1.3 metre) were measured and tagged, to the nearest possible centimetre, as well as each individual heights (Hubbell and Foster 1983; Condit *et al*. 1995). Leaves, fruits, barks and special characteristics (e.g. sap, latex and smell) of the individual trees were collected and recorded for further studies. Identifications were based on reports by Ridley (1967), Whitmore and Tantra (1986), Lemmens *et al.* (1994), Soerianegara and Lemmens (1994) and Newman *et al.* (1996a, b).

As for non-woody and herbaceous plants, the species were assessed in each study site, whereby a 120 m belt-transect was deployed along the open forest trail adjacent to the plot for woody species. A quadrat (1x1 m) was placed at 5 meter intervals along the forest trails immediate to the forest edge generating a total of 20 quadrats per transect. Definition of forest edge was based upon Harper *et al.* (2005). All non-woody species within the sampling quadrat were identified and recorded, i.e. all herbs and shrubs species, excluding orchids and ferns. Any special features (e.g. flowers, fruits and plant excretions) were documented to assist with the identifications. The collected specimens were deposited at the Universitas Syiah Kuala (Unsyiah), Aceh, Indonesia for future references. The resulting checklists were generated from the recorded specimens.

It should be noted that there are limitations to the

Table 1. List of sampling sites on the Weh Island with their respective forest type.

STUDY SITE (CODE)	FOREST TYPE	LOCATION	ALTITUDE (M/ASL)
Ujong Nol (*Un*)	Primary coastal forest	05°54'20" N, 95°13'14" E	70
KM Nol 1(*Nol-1*)	Primary lowland forest	05°54'06" N, 95°13'39" E	130
KM Nol 2 (*Nol-2)*	Primary lowland forest	05°54'05" N, 95°13'32" E	
Lhong Angeen Coastal Forest 1 (*LaC-1*)	Primary coastal forest	05°50'59" N, 95°15'10" E	50-110
Lhong Angeen Coastal Forest 2 (*LaC- 2*)	Primary coastal forest	05°50'56" N, 95°15'04" E	
Paya Sinara Hill Inland Forest (*PsH*)	Hill forest	05°49'59" N, 95°19'06" E	250-350
Waterfall Trail (*WfT*)	Riverine disturbed forest	05°49'47" N, 95°18'15" E	150-300

collected data; 1) records were made on species which were found only within the established study plot and line transect AND this strictly limits the number of species recorded; 2) this rapid assessment for non-woody species only covers the herbs and shrubs (excluding ferns and orchids) especially the weedy species component of Weh Island flora; and 3) assessments were carried out within a limited time-line (one off) and only covered five known disturbed habitats of Sabang. To compensate for these limitations, further surveys and detailed species enumeration including expanding the survey sites and locality is being planned.

Results and Discussion

In total, we recorded 325 species of plant where 247 and 78 were woody (W) and non-woody (NW) species, respectively (Table 2). Nine predominant families (i.e. with number of species ≥ 10 in each family), namely Euphorbiaceae (32 species), Cyperaceae (19 spp.), Fabaceae (17 spp.), Moraceae (15 spp.), Meliaceae (13 spp.), Lauraceae and Sterculiaceae (each 12 spp., respectively), Rubiaceae (11 spp.) and Annonaceae (10 spp.) were listed. The observed dominance of these families on this island are similar to other studies conducted within the Southeast Asian region such as Malaysia (Kochummen *et al.* 1990; Okuda *et al.* 2003), Philippine (Langenberger *et al.* 2006), and Vietnam (Blanc *et al.* 2001). Although the floristic composition may differ from site to site, in general these are the families frequently recorded in evergreen lowlands to hill dipterocarp forests.

The most dominant woody species, in terms of occurrence was *Pterospermum diversifolium* (Sterculiaceae). This species was recorded in all sampling sites, which could indicate a highly successful seed dispersal mechanism as well as seedling establishment. Studies on the effectiveness of winged seeds in Sterculiaceae have shown positive results (Yamada and Suzuki 1999). In addition, Yamada *et al.* (2007) reporting on habitat differences of Sterculiacceae, suggested that *P. diversifolium* could thrive well in any slopes and ridged areas of a locality, which could explain the abundance of this species in all study plots. Another frequently recorded species of Sterculiaceae was *Sterculia parvifolia* (recorded in six plots; Table 2). Five other dominant species were *Aglaia pachyphylla* (Meliaceae), *Beccaurea racemosa* (Euphorbiaceae), *Bombax velutinii* (Bombaceae), *Strombosia ceylanica* (Olacaceae) and *Ziziphus* sp. (Rhamnaceae). Although these families are usually not the most dominant (excluding Euphorbiaceae) in terms of family occurrences in many tropical rain forests in Asia, they still have significant contributions to lowland tropical rain forests with overall woody compositions (Ashton and Hall 1992; Manokaran and Swaine 1994; Curran *et al.* 2004). In addition, *S. ceylanica* is a dominant species in areas with sandstone and granite, as reported by Cannon and Leighton (2004) which could explain the dominance of this species in Weh Island, an active volcanic island.

On the composition of non-woody species, the two predominant species were *Chromoleana odorata* (Asteraceae) and *Stachytarpheta cayennensis* (Verbenaceae), found in all the surveyed sites. Other important ecological weeds; *Imperata cylindrica* (Poaceae; cogongrass or *alang-alang*) and *Lantana camara* (Verbenaceae; big sage or *bunga tahi ayam*) are also common species of open and disturbed locations. A population of an aquatic invasive plant species, *Eichornia crassipes* (Pontederiaceae; water hyacinth or *keladi bunting*) was also detected in a water canal (Table 1; Site *WfT*).

Non-woody species reported here are most commonly found in open canopy areas in a forest ecosystem. The sedges (Cyperaceae) and grasses (Poaceae) are two most common plants of disturbed ecosystem as well as Melastomataceae which is another key indicator of degraded habitats (Mishra *et al.* 2003). These families have also been associated with the regenerating process in disturbed forests (e.g. Bush and Colinvaux, 1994). Among the two Melastomataceae, the *Melastoma malabathricum* and *Clidemia hirta* have been recorded on Weh Island and although both are very common pioneer species in disturbed areas (Asyraf and Mashhor 2001; 2002), the intrusion of the later species into protected forest areas could alter the potential of the forest's regeneration cycle (Peters 2006).

Ecosystem-alterations that are related to human activities can create suitable establishment sites as well as enhance propagule dispersal of invasive species especially at the forest edges. A study conducted by Lopez de Casenave *et al.* (1995) suggested that light exposure at the edge, stimulates germination and enhances growth of pioneer species (Williams-Linera 1990; Aide and Cavelier 1994). A unique character of road sides is the repeatedly disturbed habitat (Gelbard and Belnap 2003) which creates essential corridor for colonization. Thus it is common for roadside floras to be dominated by non-native species and studies from high-traffic urban areas demonstrated that motor vehicles disperse a disproportionately large number of seeds of invasive species (Clifford 1959; Von der Lippe and Kowarik 2007). Veldman *et al.* (2009) has shown that interior forest areas, once isolated from alien species are now facing possible threats from alien grass, brought

in unintentionally through logging trucks. This similar scenario was also observed on Weh Island where road constructions into primary forest area may have resulted in high number of exotic species occurrences. In addition, frequent visits by tourist in these locations may increase propagule distribution into forest areas (see example of case studies by Wittenberg and Cock 2001). Soil containing seeds of invasive species from the mainland could also been transferred to other places within the island. One particular species of concern is the *Mimosa pigra* which is easily transported from site to site (Asyraf and Crawley 2011).

In conclusion, the composition and distribution of both woody and non-woody pioneer species are mainly dictated by the geological history of the area, the adaptive feature of the species as well as human related activities. The construction of road plays important role in the plant propagule movement into isolated forest. Land and forest manager would play a crucial role in preventing alien plant invasion by frequent monitoring and policing.

Table 2. List of the species and their respective families and their occurrence in the sampling plots.

FAMILY	SPECIES	CATEGORY	Un	La-1	La-2	Nol-1	Nol -2	PsH	WtF
Acanthaceae	*Asystasia coromandeliana*	NW	1	1				1	1
Acanthaceae	*Asystasia intrusa*	NW	1				1		1
Alangiaceae	*Alangium ridleyii*	WD					1	1	
Alangiaceae	*Alangium kunslerianum*	WD		1					
Amaranthaceae	*Amaranthus spinosus*	NW						1	
Anacardiaceae	*Antiaris toxicaria*	WD		1				1	
Anacardiaceae	*Dracontomelon dao*	WD						1	1
Anacardiaceae	*Semecarpus curtisii*	WD						1	1
Anacardiaceae	*Mangifera odorata*	WD						1	
Anacardiaceae	*Parishia insignis*	WD					1		
Anacardiaceae	*Spondias cytherea*	WD							1
Anacardiaceae	*Spondias pinnata*	WD							1
Anacardiaceae	*Swintonia spicifera*	WD						1	
Annonaceae	*Mezzetia parviflora*	WD			1	1	1		
Annonaceae	*Polyalthia clavigera*	WD		1	1		1		
Annonaceae	*Stelechocarpus cauliflorus*	WD		1		1	1		
Annonaceae	*Polyalthia jengkinsii*	WD		1			1		
Annonaceae	*Diospyros bibracteata*	WD		1					
Annonaceae	*Goniothalamus sp.*	WD						1	
Annonaceae	*Meiogyne monosperma*	WD		1					
Annonaceae	*Mitrephora maingayi*	WD		1					
Annonaceae	*Platymitra multiflora*	WD					1		
Annonaceae	*Polyalthia cauliflora*	WD					1		
Apocynaceae	*Alstonia macrophylla*	WD		1				1	1
Apocynaceae	*Alstonia angustiloba*	WD						1	1
Apocynaceae	*Ochrosia oppositifolia*	WD		1					
Apocynaceae	*Tabernaemontana sphaerocarpa*	WD		1					
Araliaceae	*Atrophyllum maingayi*	WD							1
Araliaceae	*Hederopsis maingayi*	WD						1	
Araliaceae	*Traversia buckii*	WD						1	
Arecaceae	*Arenga pinnata*	NW						1	1
Arecaceae	*Caryota mitis*	NW						1	1
Arecaceae	*Oncosperma horridum*	NW							1
Arecaceae	*Pinanga malayana*	NW						1	
Arecaceae	*Saraca* sp.	NW							1
Arecaceae	*Atrophyllum* sp.	WD						1	
Asteraceae	*Chromoleana odorata*	NW	1	1			1	1	1
Asteraceae	*Bidens pilosa*	NW		1			1	1	1
Asteraceae	*Tridax procumbens*	NW	1				1	1	
Asteraceae	*Pulchea indica*	NW		1					1
Asteraceae	*Spilanthes paniculata*	NW	1			1			
Bignoniaceae	*Radermachera pinnata*	WD				1	1		
Bignoniaceae	*Oroxylum indicum*	WD							1
Bombacaceae	*Bombax velutinii*	WD		1		1	1	1	1
Boraginaceae	*Cordia subcordata*	WD		1					
Burseraceae	*Canarium litoralle var. litoralle*	WD		1		1		1	1
Burseraceae	*Scutinanthe brunea*	WD					1	1	

TABLE 2. ***CONTINUED.***

FAMILY	SPECIES	CATEGORY	Un	La-1	La-2	Nol-1	Nol -2	PsH	WtF
Burseraceae	*Canarium pachyphyllum*	WD					1		
Burseraceae	*Canarium pillosum*	WD						1	
Burseraceae	*Dacryodes* sp.	WD					1		
Burseraceae	*Santiria laevigata*	WD						1	
Celastraceae	*Lophopetalum pallidum*	WD		1	1	1	1		
Celastraceae	*Lophopetalum subobovatum*	WD		1			1	1	
Celastraceae	*Kokoona littoralis*	WD	1					1	
Celastraceae	*Bhesa paniculata*	WD						1	
Celastraceae	*Lophopetalum floribundum*	WD		1					
Chrysobalanaceae	*Licania splenden*	WD			1				
Chrysobalanaceae	*Parastemon urophyllus*	WD			1				
Chrysobalanaceae	*Prunus polystachia*	WD					1		
Clusiaceae	*Calophyllum inophyllum*	WD						1	1
Clusiaceae	*Garcinia malaccensis*	WD		1	1				
Clusiaceae	*Garcinia nigrolineata*	WD		1				1	
Clusiaceae	*Garcinia* sp.	WD		1	1				
Clusiaceae	*Calophyllum soultari*	WD						1	
Clusiaceae	*Calophyllum tetrapterum var. incrassatum*	WD						1	
Clusiaceae	*Garcinia hombroneana*	WD						1	
Clusiaceae	*Garcinia parvifolia*	WD	1						
Clusiaceae	*Garcinia prainiana*	WD	1						
Combretaceae	*Terminalia catappa*	WD		1					
Crypteroniaceae	*Crypteronia griffitiana*	WD							1
Ctenolophonaceae	*Ctenolophon parvifolius*	WD			1		1		
Cyperaceae	*Cyperus aromaticus*	NW	1	1		1			1
Cyperaceae	*Cyperus diffusus*	NW	1				1	1	1
Cyperaceae	*Cyperus rotandus*	NW	1		1		1		1
Cyperaceae	*Fimbristylis acuminata*	NW	1	1				1	1
Cyperaceae	*Cyperus cyperinus*	NW	1				1		1
Cyperaceae	*Fimbristylis pauciflora*	NW	1	1				1	
Cyperaceae	*Mapania palustris*	NW	1					1	1
Cyperaceae	*Panicum repens*	NW	1				1		1
Cyperaceae	*Scleria bancana*	NW	1				1		1
Cyperaceae	*Cyperus compresus*	NW					1	1	
Cyperaceae	*Cyperus distans*	NW	1						1
Cyperaceae	*Gahnia tristis*	NW		1					1
Cyperaceae	*Cyperus halpan*	NW					1		
Cyperaceae	*Fimbristylis miliaceae*	NW					1		
Cyperaceae	*Mapania cuspidata*	NW						1	
Cyperaceae	*Mapania kurzii*	NW							1
Cyperaceae	*Mapania tenuiscapa*	NW		1					
Cyperaceae	*Rhynchospora aurea*	NW		1					
Cyperaceae	*Scleria purpurescens*	NW						1	
Dilleniaceae	*Dillenia pulchella*	WD		1					
Dioscoreaceae	*Dioscorea pyrifolia*	WD		1				1	1
Dracaenaceae	*Dracaena elliptica*	WD		1		1			
Ebenaceae	*Diospyros kurzii*	WD	1	1	1	1			
Ebenaceae	*Diospyros borneensis*	WD		1		1	1		
Ebenaceae	*Diospyros singaporensis*	WD		1	1		1		
Ebenaceae	*Diospyros clavigera*	WD		1	1				
Ebenaceae	*Diospyros dictyoneura*	WD					1	1	
Ebenaceae	*Diospyros diepenhorstii*	WD							1
Ebenaceae	*Diospyros kaki*	WD						1	
Ebenaceae	*Diospyros toposioides*	WD							1
Ebenaceae	*Diospyros wallichii*	WD							1
Erythroxylaceae	*Erythroxylum cuneatum*	WD		1	1				
Euphorbiaceae	*Baccaurea racemosa*	WD		1	1	1	1	1	
Euphorbiaceae	*Suregada multiflora*	WD	1	1	1	1			

TABLE 2. ***CONTINUED.***

FAMILY	SPECIES	CATEGORY	Un	La-1	La-2	Nol-1	Nol -2	PsH	WtF
Euphorbiaceae	*Cleistanthus sumatranus*	WD		1	1	1			
Euphorbiaceae	*Euphorbia hirta*	NW	1	1					1
Euphorbiaceae	*Phyllanthus niruri*	NW	1	1			1		
Euphorbiaceae	*Acalypha indica*	WD						1	1
Euphorbiaceae	*Bridelia stipularis*	WD						1	1
Euphorbiaceae	*Croton hirtus*	NW	1	1					
Euphorbiaceae	*Drypetes longifolia*	WD				1	1		
Euphorbiaceae	*Glochidion wallichianum*	WD		1					1
Euphorbiaceae	*Jatropha grossypifolia*	WD		1					1
Euphorbiaceae	*Macaranga tanarius*	WD		1					1
Euphorbiaceae	*Mallotus khorthalsii*	WD		1				1	
Euphorbiaceae	*Alchornea rugosa*	WD							1
Euphorbiaceae	*Aleorites moluccana*	WD						1	
Euphorbiaceae	*Antidesma cuspidatum*	WD						1	
Euphorbiaceae	*Austrobuxus nitidus*	WD			1				
Euphorbiaceae	*Bridelia pustulata*	WD						1	
Euphorbiaceae	*Cnesmone javanica*	WD						1	
Euphorbiaceae	*Croton argyratus*	WD	1						
Euphorbiaceae	*Drypetes laevis*	WD					1		
Euphorbiaceae	*Drypetes polyneura*	WD				1			
Euphorbiaceae	*Glochidion hypoleucum*	WD						1	
Euphorbiaceae	*Glochidion sericeum*	WD						1	
Euphorbiaceae	*Jatropha curcas*	WD							1
Euphorbiaceae	*Macaranga conifera*	WD						1	
Euphorbiaceae	*Macaranga recurvata*	WD						1	
Euphorbiaceae	*Mallotus dispar*	WD							1
Euphorbiaceae	*Mallotus microstachyus*	WD						1	
Euphorbiaceae	*Phyllanthus urinaria*	NW	1						
Euphorbiaceae	*Sapium baccatum*	WD							1
Euphorbiaceae	*Sauropus androgynus*	WD		1					
Fabaceae	*Calopogonium mucunoides*	NW	1		1		1		1
Fabaceae	*Mimosa invisa*	NW	1	1			1		1
Fabaceae	*Mimosa pudica*	NW	1				1		1
Fabaceae	*Cassia alata*	NW	1				1		
Fabaceae	*Diailium indum*	WD		1				1	
Fabaceae	*Saraca* sp.	WD					1	1	
Fabaceae	*Adenanthera bicolor*	WD				1			
Fabaceae	*Archidendron jiringa*	WD			1				
Fabaceae	*Callerya atropurpurea*	WD							1
Fabaceae	*Delonix regia*	WD			1				
Fabaceae	*Dialium hydnocarpoides*	WD		1					
Fabaceae	*Dialium procerum*	WD						1	
Fabaceae	*Intsia bijuga*	WD							1
Fabaceae	*Milettia pinnata*	WD		1					
Fabaceae	*Parkia speciosa*	WD		1					
Fabaceae	*Senna alata*	WD							1
Fabaceae	*Senna glauca*	WD							1
Flacourtiaceae	*Pangium edule*	WD	1	1				1	
Flacourtiaceae	*Homalium longifolium*	WD						1	
Gesneriaceae	*Didymocarpus* sp.	WD							1
Gnetaceae	*Gnetum gnemon*	WD						1	1
Hernandiaceae	*Hernandia nymphaeifolia*	WD		1					
Lauraceae	*Endiandra maingayi*	WD		1		1		1	
Lauraceae	*Neolitsea zeylanica*	WD		1				1	1
Lauraceae	*Beilschmiedia palembanica*	WD						1	1
Lauraceae	*Actinodaphne pruinosa*	WD					1		
Lauraceae	*Beilschmiedia insignis*	WD							1
Lauraceae	*Beilschmiedia lucidula*	WD						1	

TABLE 2. ***CONTINUED.***

FAMILY	SPECIES	CATEGORY	Un	La-1	La-2	Nol-1	Nol -2	PsH	WtF
Lauraceae	*Dehaasia polyneura*	WD							1
Lauraceae	*Dehassia cuneata*	WD			1				
Lauraceae	*Dehassia pauciflora*	WD						1	
Lauraceae	*Litsea elliptica*	WD							1
Lauraceae	*Litsea grandis*	WD						1	
Lauraceae	*Litsea michilifolia*	WD	1						
Lauraceae	*Neolitsea kedahensis*	WD						1	
Leeaceae	*Leea indica*	WD		1				1	1
Lecythidaceae	*Baringtonia asiatica*	WD		1					
Lecythidaceae	*Barringtonia* sp.	WD							1
Linderniaceae	*Lindernia crustacea*	NW	1		1		1		1
Malvaceae	*Urena lobata*	NW	1				1		1
Malvaceae	*Thespesia populnea*	WD		1					
Melastomataceae	*Clidermia hirta*	NW	1				1		1
Melastomataceae	*Memecylon* sp.	NW	1						1
Melastomataceae	*Pternandra* sp.	NW	1					1	
Melastomataceae	*Melastoma malabathricum*	WD							1
Meliaceae	*Aglaia pachyphylla*	WD	1	1	1	1	1		
Meliaceae	*Sandoricum koetjape*	WD		1		1		1	1
Meliaceae	*Lansium domesticum*	WD		1		1		1	
Meliaceae	*Aglaia cinerea*	WD		1			1		
Meliaceae	*Aglaia exstipulata*	WD				1	1		
Meliaceae	*Cheisocheton patens*	WD				1	1		
Meliaceae	*Dysoxylum alliaceum*	WD					1		1
Meliaceae	*Aglaia forbesii*	WD						1	
Meliaceae	*Aglaia rubescens*	WD					1		
Meliaceae	*Dysoxylum acutangulum*	WD					1		
Meliaceae	*Dysoxylum flavescens*	WD				1			
Meliaceae	*Dysoxylum* sp.	WD		1					
Meliaceae	*Toona sureni*	WD		1					
Memecylaceae	*Memecylon megacarpum*	WD						1	
Memecylaceae	*Memecylon* sp.	WD	1						
Moraceae	*Artocarpus nitidus var. griffitthii*	WD		1					1
Moraceae	*Ficus callosa*	WD		1				1	
Moraceae	*Ficus schwarzii*	WD						1	1
Moraceae	*Prainea limpato*	WD				1	1		
Moraceae	*Streblus asper*	WD			1	1			
Moraceae	*Artocarpus elasticus*	WD							1
Moraceae	*Artocarpus maingayi*	WD						1	
Moraceae	*Artocarpus rigidus*	WD							1
Moraceae	*Ficus chartacea*	WD							1
Moraceae	*Ficus fistulosa*	WD	1						
Moraceae	*Ficus sinuate*	WD							1
Moraceae	*Ficus sundaicus*	WD		1					
Moraceae	*Ficus uncinata*	WD						1	
Moraceae	*Ficus variegata*	WD		1					
Moraceae	*Streblus illicifolius*	WD		1					
Myristicaceae	*Knema intermedia*	WD	1	1	1				
Myristicaceae	*Endocomia canaroides*	WD						1	
Myristicaceae	*Horsfieldia polyspherula var.sumatrana*	WD					1		
Myristicaceae	*Knema stenophyla*	WD			1				
Myristicaceae	*Myristica malaccensis*	WD		1					
Myrsinaceae	*Ardisia elliptica*	WD		1				1	1
Myrsinaceae	*Ardisia pachysandra*	WD						1	
Myrsinaceae	*Ardisia* sp.	WD		1					
Myrtaceae	*Syzygium ridleyii*	WD		1		1	1		
Myrtaceae	*Syzygium cerasiforme*	WD				1	1		
Myrtaceae	*Syzygium grande*	WD	1	1					

TABLE 2. ***CONTINUED.***

FAMILY	SPECIES	CATEGORY	Un	La-1	La-2	Nol-1	Nol -2	PsH	WtF
Myrtaceae	*Syzygium* sp.	WD					1	1	
Myrtaceae	*Eugenia caryophyllata*	WD							1
Myrtaceae	*Eugenia* sp16	WD	1						
Olacaceae	*Strombosia ceylanica*	WD	1	1	1			1	1
Olacaceae	*Radermachera pinnata*	WD				1			
Oleaceae	*Chionanthus cauliflorus*	WD						1	
Oleaceae	*Chionanthus macrocarpus*	WD						1	
Oleaceae	*Olea dentata*	WD							1
Onagraceae	*Ludwigia octovalvis*	NW			1			1	
Pandanaceae	*Pandanus artocarpus*	WD		1					
Pandanaceae	*Pandanus odoratissimus*	WD		1					
Poaceae	*Cynodon dactylon*	NW	1	1			1		1
Poaceae	*Imperata cylindrica*	NW	1				1	1	1
Poaceae	*Acroceras munroanum*	NW	1	1			1		
Poaceae	*Axonapus compresus*	NW	1		1		1		
Poaceae	*Chloris barbata*	NW	1	1			1		
Poaceae	*Ottochloa nodosa*	NW	1				1		1
Poaceae	*Panicum amplexicaule*	NW	1				1		1
Poaceae	*Panicum brevifolium*	NW	1		1				1
Poaceae	*Panicum repens*	NW	1				1		1
Poaceae	*Zoysia matrella*	NW	1					1	1
Poaceae	*Eriachne pallescens*	NW					1		1
Poaceae	*Lophatherum gracile*	NW						1	1
Poaceae	*Paspalum scrobiculatum*	NW		1	1				
Poaceae	*Pennisetum polystachion*	NW	1	1					
Poaceae	*Setaria palmifolia*	NW						1	1
Poaceae	*Themeda arguens*	NW			1				1
Poaceae	*Eleusine indica*	NW						1	
Poaceae	*Ischaemum muticum*	NW					1		
Poaceae	*Panicum trigonum*	NW					1		
Polygalaceae	*Xanthophyllum obovatum*	WD						1	
Polygalaceae	*Xanthophylum schortechinii*	WD				1			
Polypodiaceae	*Acrosthicum aureum*	WD		1					
Pontederiaceae	*Eichornia crassipes*	NW							1
Proteaceae	*Helicia attenuata*	WD							1
Proteaceae	*Helicia excelsa*	WD		1					
Rhamnaceae	*Ziziphus* sp.	WD	1	1	1	1	1		
Rhamnaceae	*Ziziphus maritima*	WD							1
Rhizophoraceae	*Carallia bractiata*	WD						1	1
Rhizophoraceae	*Bruguiera gymnorrhiza*	WD		1					
Rubiaceae	*Hedyotis capitellata*	NW					1	1	1
Rubiaceae	*Hedyotis corymbosa*	NW	1		1				1
Rubiaceae	*Nauclea orientalis*	WD					1		1
Rubiaceae	*Agrostemma involucratum*	NW							1
Rubiaceae	*Agrostemma spinulosum*	NW	1						
Rubiaceae	*Guettada speciosa*	WD		1					
Rubiaceae	*Ixora grandiflora*	WD						1	
Rubiaceae	*Ixora lobii*	WD		1					
Rubiaceae	*Neolamarckia cadamba*	WD							1
Rubiaceae	*Ochrosia oppositifolia*	WD		1					
Rubiaceae	*Schyphiphora hydrophyllacea*	WD		1					
Rutaceae	*Merope angulata*	WD	1			1			
Rutaceae	*Citrus aurenttifolia*	WD		1					
Rutaceae	*Citrus medica*	WD	1						
Rutaceae	*Melicope glabra*	WD							1
Rutaceae	*Micromelum minutum*	WD		1					
Rutaceae	*Zanthoxylum myriacanthum*	WD		1					
Rutaceae	*Zanthoxylum nitidum*	WD						1	

TABLE 2. ***CONTINUED.***

FAMILY	SPECIES	CATEGORY	Un	La-1	La-2	Nol-1	Nol -2	PsH	WtF
Rutaceae	*Zantoxylum myriachantum*	WD				1			
Sapindaceae	*Allophyllus cobbe var. marinus*	WD		1				1	
Sapindaceae	*Lepisanthes fruiticosa*	WD		1				1	
Sapindaceae	*Nephelium maingayi*	WD		1	1				
Sapindaceae	*Pomettia ridleyii*	WD						1	1
Sapindaceae	*Xerospermum laevigatum*	WD		1	1				
Sapindaceae	*Glenniea penangensis*	WD					1		
Sapindaceae	*Lepisanthes tetraphllya*	WD						1	
Sapindaceae	*Litchi chinensis*	WD			1				
Sapindaceae	*Miscocharpus pentapetalus*	WD					1		
Sapotaceae	*Madhuca hirtiflora*	WD		1	1	1			
Sapotaceae	*Palaqium obovatum*	WD		1				1	
Sapotaceae	*Palaquium stellatum*	WD					1	1	
Sapotaceae	*Madhuca laurifolia*	WD		1					
Sapotaceae	*Madhuca malaccensis*	WD						1	
Sapotaceae	*Palaqium rostratum*	WD		1					
Sapotaceae	*Palaquium obovatum*	WD	1						
Sapotaceae	*Palaquium* sp.	WD	1						
Sapotaceae	*Payena maingayi*	WD							1
Staphyleaceae	*Turpinia sphaerocarpa*	WD		1					1
Sterculiaceae	*Pterospermum diversifolium*	WD	1	1	1	1	1	1	1
Sterculiaceae	*Sterculia parvifolia*	WD	1	1	1	1	1		1
Sterculiaceae	*Pterocymbium javanicum*	WD				1	1	1	1
Sterculiaceae	*Sterculia foetida*	WD			1	1		1	1
Sterculiaceae	*Sterculia cordata*	WD						1	1
Sterculiaceae	*Abroma augusta*	WD						1	
Sterculiaceae	*Firmiana malayana*	WD		1					
Sterculiaceae	*Pterocymbium tubulatum*	WD		1					
Sterculiaceae	*Pterospermum javanicum*	WD							1
Sterculiaceae	*Sterculia coccinea*	WD							1
Sterculiaceae	*Sterculia macrophylla*	WD			1				
Sterculiaceae	*Sterculia rubiginosa var. hirta*	WD						1	
Styracaceae	*Styrax benzoin*	WD							1
Tiliaceae	*Grewia laviegata*	WD		1					
Tiliaceae	*Pentace triptera*	WD		1					
Ulmaceae	*Trema* sp.	WD							1
Urticaceae	*Laportea stimulans*	WD						1	
Verbenaceae	*Stachytarpheta cayennensis*	NW	1		1	1	1	1	1
Verbenaceae	*Stachytarpheta jamaicensis*	NW	1		1	1	1	1	
Verbenaceae	*Lantana camara*	WD	1	1			1		1
Verbenaceae	*Vitex pinnata*	WD		1	1			1	1
Verbenaceae	*Clerodendron paniculatum*	WD		1					1
Verbenaceae	*Vitex trifolia*	WD		1				1	
Zingiberaceae	*Alpinia javanica*	NW	1		1			1	
Zingiberaceae	*Globba* sp.	NW						1	1
Zingiberaceae	*Zingiber gracile*	NW						1	1

ACKNOWLEDGMENTS: This research project is part of an expedition organized by Universiti Sains Malaysia (USM) with the collaboration of Universitas Syiah Kuala (Unsyiah), Banda Aceh in April 2010. We thank the Department of Research, Universiti Sains Malaysia under Research University Grant (Grant no. 10101/JNC/AUPRM001) for providing the fund and the Unsyiah for technical support, logistic and local hospitality.

LITERATURE CITED

Aide, T.M. and J. Cavelier. 1994. Barriers to lowland tropical forest restoration in the Sierra Nevada De Santa Marta. Colombia. *Restoration Ecology* 2(4): 219-229.

Aiken S.R. and C.H. Leigh. 1992. *Vanishing Rain Forest. The Ecological Transition in Malaysia*. Oxford: Clarendon Press.

Ashton, P.S. and P. Hall 1992. Comparison of structure among mixed dipterocarp forests of north-western Borneo. *Journal of Ecology* 80: 459-481.

Asyraf, M. and M. Mashhor. 2001. Weedy plants of Ayer Hitam Forest Reserve, Selangor. *Pertanika Journal Tropical Agricultural Science* 24(1): 1-5.

Asyraf, M. and M. Mashhor 2002. Diversity and composition of weeds in disturbed and undisturbed peat swamp forest in Peninsular Malaysia. *In* J.O Rieley, S.E. Page, and B. Setiadi (ed.)*Peatlands for people: natural resource functions and sustainable management.* Jakarta: BPPT.

Asyraf, M., and M.J. Crawley. 2011. Current Status of *Mimosa pigra* L. Infestation in Peninsula Malaysia. *Tropical Life Sciences Research*

22(1): 41–55.
Blanc, L., G. Maury-Lechon, and J.P. Pascal. 2001. Structure, floristic composition and natural regeneration in the forests of Cat Tien National Park, Vietnam: an analysis of the successional trends. *Journal of Biogeography* 27: 41–157.
Bush, M.B. and P.A. Colinvaux. 1994. Tropical Forest Disturbance: Paleoecological Records from Darien, Panama. *Ecology*, 75(6): 1761-1768.
Cannon, C.H. and M. Leighton. 2004. Tree species distributions across five habitats in a Bornean rain forest. *Journal of Vegetation Science* 15: 257-266.
Clifford, H. T. 1959. Seed dispersal by motor vehicles. *Journal of Ecology* 47: 311-315.
Condit, R., S.P. Hubbell, J.V. Lafrankie, R. Sukumar, N. Manokaran, R.B. Foster, and P.S. Ashton. 1995. Species-area and species-individual relationships for tropical trees: a comparison of three 50-ha plots. *Journal of Ecology* 84:549-562.
Corlett, S.T. 2010. Invasive aliens on tropical East Asian islands. *Biodiversity Conservation* 19: 411–423.
Curran, L., M. Trigg, S. McDonald, A. Astiani, D. Hardiono, Y.M. Siregar, P. Caniago, I. and E. Kasischke. 2004. Lowland forest loss in protected areas of Indonesian Borneo. *Science* 303: 1000-1003.
Dansereau, P. 1960. The origin and growth of plant communities. p.563-603. *In* M.X. Zarrow (ed.). *Growth in Living System: Proceedings of International Symposium on Growth, Purdue University. Indiana*. New York: Basic Books.
Davis, G. and D. Richardson. 1995. *Mediterranean Type Ecosystems: The Function of Biodiversity*. Berlin: Springer.
Fuller, D.O., E.M. Meijaard, L. Christy, and T.C. Jessup. 2010. Spatial assessment of threats to biodiversity within East Kalimantan, Indonesia. *Applied Geography*, 30(3): 416–425.
Gasparon, M. 2005. Quaternary Volcanicity in Sumatra: Geology, Resources and Tectonic Evolution. p.120-130. *In* A.J. Barber, M.J. Crow and J.S. Milsom (ed.). *Memoirs 31*. London: Geological Society.
Gelbard, J.L. and J. Belnap. 2003. Roads as conduits for exotic plant invasions in a semiarid landscape. *Conservation Biology* 17: 420–432.
Harper, K.A., S.E. Macdonald, P.J. Burton, J. Chen, K.D. Brosofske, S.C. Saunders, E.S. Euskirchen, D. Roberts, M.S. Jaiteh, P.A. Esseen. 2005. Edge influence on forest structure and composition in fragmented landscapes. *Conservation Biology* 19(3): 768-782.
Hayasaka, D., K. Fujiwara, and E.O. Box. 2009. Recovery of sandy beach and maritime forest vegetation on Phuket Island (Thailand) after the major Indian Ocean tsunami of 2004. *Applied Vegetation Science* 12: 211–224.
Hubbell, S.P. and R.B. Foster. 1983. Diversity of canopy trees in a neotropical forest and implications for conservation. p 25-41. *In* S.L. Sutton, T.C. Whitmore and A.C. Chadwick AC (ed.), *Tropical Rain Forest: Ecology and Management*. Oxford: Blackwells.
Kochummen, K.M., Jr.J.V. LaFrankie, and N. Manokaran. 1990. Floristic composition of Pasoh Forest Reserve, a lowland rain forest in Peninsular Malaysia. *Journal of Tropical Forest Science* 3(1): 1- 13.
Langenberger, G., K. Martin, and J. Sauerborn. 2006. Vascular plant species inventory of a Philippine lowland rain forest and its conservation value. *Biodiversity and Conservation,* 15: 1271–1301.
Lemmens, R.H.J., I. Soerianegara, and W.C. Wong. 1994. *Timber trees: Major commercial timbers*. Bogor Indonesia: Prosea Foundation. Plant Resources of South-East Asia 5:2
Lopez de-Casenave, J., J.P. Pelotto, and J. Protomastro. 1995. Edgeinterior differences in vegetation structure and composition in a Chaco semi-arid forest, Argentina. *Forest Ecology and Management* 72: 61-69.
Mangkoedihardjo, S. 2008. Coastal Greenspace for depollution of inland sanitation practices and sea-based Sources. *International Conference-Sustainable Environmental Technology and Sanitation for Tropical Region 10*. Surabaya: Nopember Institute of Technology.
Manokaran, N. and M.D. Swaine. 1994. Population dynamics of trees in Dipterocarp Forests of Peninsular Malaysia. *Malayan Forest Records 40*. Kepong: Forest Research Institute of Malaysia. 50 p.
Mattsson, E., M. Ostwald, S.P. Nissanka, B. Holmer, and M. Palma. 2008. Recovery and protection of coastal ecosystems after tsunami event and potential for participatory forestry CDM – Examples from Sri Lanka. *Ocean & Coastal Management* 52: 1–9.
Mishra, B.P., O. P. Tripathi, R.S. Tripathi, and H.N. Pandey. 2003. Effects of anthropogenic disturbance on plant diversity and community structure of a sacred grove in Meghalaya, northeast India. *Biodiversity and Conservation,* 13: 421-436.
Newman, M.F., P.F. Burgess, and T.C. Whitmore. 1996a. *Manuals of Dipterocarps for Foresters: Sumatra Light Hardwoods.* Edinburgh: Royal Botanic Garden.
Newman, M.F., P.F. Burgess, and T.C. Whitmore. 1996b. *Manuals of Dipterocarps for Foresters: Sumatra Medium and Heavy Hardwoods.* Edinburgh: Royal Botanic Garden.
Nizam, M.S., R. Suhaili, A. Latiff, and I. Faridah-Hanum. 2006. Community structure of trees in Lesong Virgin Jungle Reserve, Pahang, Malaysia. *The Malaysian Forester* 69(2):163-181.
Okuda, T., M. Suzuki, N. Adachi., E.S. Quah, N.A. Hussein, and N. Manokaran. 2003. Effect of selective logging on canopy and stand structure and tree species composition in a lowland dipterocarp forest in peninsular Malaysia. *Forest Ecology and Management* 175: 297-320.
Peters, H.A. 2006. *Clidemia hirta* invasion at the Pasoh Forest Reserve: An unexpected plant invasion in an undisturbed tropical forest. *Biotropica* 33(1): 60-68.
Rasingam, L. and N. Parthasarathy. 2009. Diversity of understory plants in undisturbed and disturbed tropical lowland forests of Little Andaman Island, India. *Biodiversity Conservation*, 18:1045–1065.
Ridley, H.N. 1967. *The Floral of The Malay Peninsula.* (Vol. 1-5). L. Reeve and Co. Brook Nr. Ashford, Great Britain.
Slik, J.W.F, S-I. Aiba, M. Bastian, F.Q. Brearley, C.H. Cannona, K.A.O. Eichhorng, G. Fredriksson, K. Kartawinata, Y. Laumonier, M. Asyraf, A. Marjokorpi, E. Meijaard, R.J. Morley, H. Nagamasu, R. Nilus, E. Nurtjahya, J. Payne, A. Permana, A.D. Poulsen, N. Raes, S. Riswani, C.P. van Schaiku, D. Sheil, K. Sidiyasa, E. Suzuki, J.L.C.H. van Valkenburg, C.O. Web, S. Wichu, T. Yoneda, R. Zakaria, and N. Zweifel. 2011. Soils on exposed Sunda Shelf shaped biogeographic patterns in the equatorial forests of Southeast Asia. *PNAS,* 108 (30): 12343-12347.
Soerianegara, I. and R.H.J. Lemmens. 1994. *Timber trees: Major commercial timbers*. Bogor Indonesia: Prosea Foundation. Plant Resources of South-East Asia 5:1
Takyu, M., Y. Kubota, S. Aiba, T. Seino, and T. Nishimura. 2005. Pattern of changes in species diversity, structure and dynamic of forest ecosystems along latitudinal gradient in East Asia. *Ecological Research* 20:287-296.
Tanaka, N. 2009. Vegetation bioshields for tsunami mitigation: review of effectiveness, limitations, construction, and sustainable management. *Landscape Ecology Engineering* 5: 71–79.
Turner, I.M. 1989. An enumeration of one hectare of Pantai Aceh Forest Reserve, Penang. *Garden Bulletin of Singapore* 42: 29-44.
Verstappen, H.T. 2005. *Volcanic Island in the physical geography of South East Asia*. London: Oxford University Press.
Veldman, J.W., B. Mostacedo, P.M. A-Clasros, and E. Putz. 2009. Selective logging and fire as drivers of alien grass invasion in a Bolivian tropical dry forest. *Forest Ecology and Management* 258: 1643–1649.
Von-Der-Lippe, M. and I. Kowarik. 2007. Long-Distance Dispersal of Plants by Vehicles as a Driver of Plant Invasions. *Conservation Biology* 21(4): 986-996.
Whitmore, T.C. 1984. *Tropical Rain Forests of the Far East.* 2nd ed. Oxford: Oxford University Press.
Whitmore, T.C. and I.G.M. Tantra. 1986. *Tree Flora of Indonesia: Checklist for Sumatra*. Bongor: Forest Research and Development Centre.
Williams-Linera, G. 1990. Origin and early development of forest edge vegetation in Panama. *Biotropica* 22: 235-241.
Wittenberg, R. and M.J.W. Cock. 2001. *Invasive alien species: A toolkit of best prevention and management practices*. Wallingford: CAB International. 228 p.
Yamada, T. and E. Suzuki. 1999. Comparative morphology and allometry of winged diaspores among the Asian Sterculiaceae. *Journal of Tropical Ecology* 15: 619-635.
Yamada, T., O.P. Ngakan and E. Suzuki (2007) Habitat differences between two congeneric canopy trees, *Pterospermum javanicum* and *P. diversifolium* (Sterculiaceae) in an Indonesian floodplain forest. *Tropics,* 16(2): 166-169
Zakaria., R, M. Asyraf, N.R. Nik Fadzly, and M. Mashhor. 2009. Comparison of plant communities at six study plots in Penang forest reserves, Malaysia. *Tropical Ecology* 50(2): 259-265.

RECEIVED: November 2011
ACCEPTED: June 2012
PUBLISHED ONLINE: August 2012
EDITORIAL RESPONSIBILITY: Angelo Gilberto Manzatto